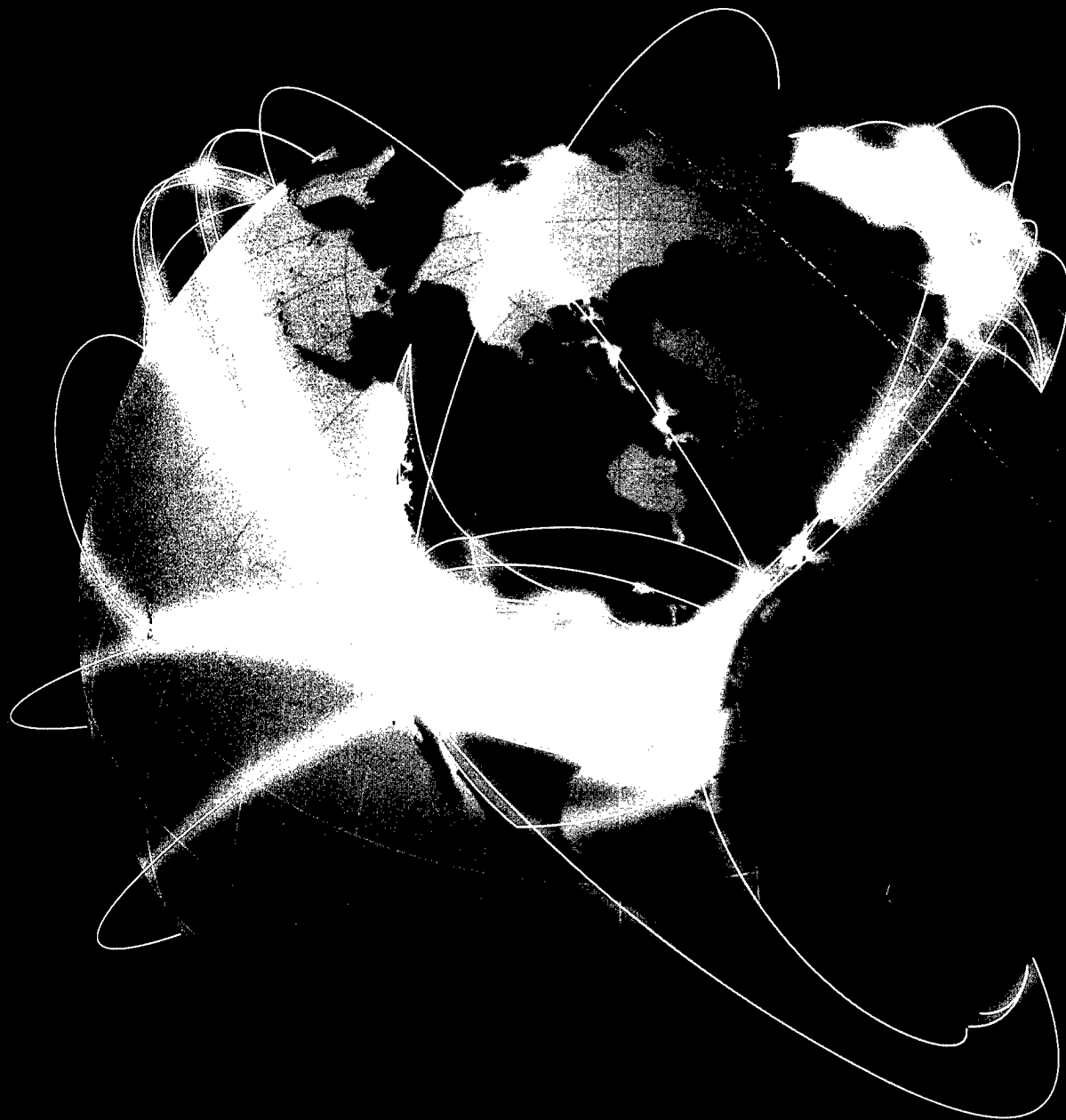


RAND REVIEW

Fall 2000

Vol. 24, No. 2



Transcendental Destination

Where Will the Information Revolution Lead?

All three feature articles in this issue interpret current events in ways that diverge markedly from standard news accounts.

Our cover story on the information revolution begins where most news stories end—by describing the technological advances we might witness in the near future and speculating about the social and economic changes that could spread around the world as a result. But that is only the beginning. Beyond these technological, social, and economic changes, the information revolution also begets the need for new institutions of governance capable of coordinating global networks of individuals and organizations. Three existing types of institutions could serve as useful models for building a global civil society. Even more intriguing, the information revolution is fostering the evolution of a global “realm of the mind,” according to some RAND researchers. In this new realm, power will stem from influential ideas as much as from material resources. The implications are especially profound for America and its efforts to craft an information strategy.

Our story on youth violence differs from news accounts that portray schoolyard killings either as a failure of the criminal justice system, a result of inadequate gun controls, or a symptom of cultural decay. The story here diagnoses youth violence, instead, as a matter of public health. Under this interpretation, youth violence is a “contagion” that can spread among susceptible adolescents under certain conditions. The researchers attempt to identify the most likely susceptibilities and the most dangerous conditions—in the hopes of mitigating both. The intent is not to discredit the efforts of law enforcement, gun controls, or cultural crusades. Rather, the ultimate aim is to prescribe additional remedies for youth violence, especially remedies that can be targeted to the specific ailments of different kinds of violent youth.

Our story on electricity deregulation challenges a common assumption about last summer’s failure of deregulation in California, the first state where deregulation took effect. Some observers blame the California crisis on a lack of surge capacity—or inadequate supplies of electricity to meet the summertime peaks in demand. In that view, the solution is pretty straightforward: Amass larger supplies of standby generating capacity. Unfortunately, the problem is more complex. Utility companies suffer also from some underlying inefficiencies, which are often the legacies of previous ways of operating in a regulated environment. The trick is to reduce those inefficiencies in ways that will not compromise the ability of utility companies to provide their customers with reliable electricity. Richard Hillestad outlines some steps that companies can take to resolve this problem.

—John Godges

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For electricity deregulation to work, surge capacity is just the beginning

By Richard Hillestad

On the Cover

There are now about 100 million Internet hosts around the world, a number that has nearly doubled almost every year since 1982, according to the Internet Software Consortium, a nonprofit organization based in Redwood City, Calif. RAND researchers estimate that about half of all Internet users today reside in either the United States or Canada. High-speed Internet connections exist almost exclusively between the United States and Europe and between the United States and Asia. There are very few high-speed links to or among developing countries.

ILLUSTRATION BY PETER SORIANO

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Congratulations on your special presidential election issue (*RAND Review*, Summer 2000). The issue provides interesting reading, thoughtful arguments, and a challenge to both campaigns. It could well become a model of think tank contributions to improve the quality of choice that is essential to modern democracy.

Werner Weidenfeld

Director, Center for Applied Policy Research
University of Munich
Munich, Germany

I have read the special presidential election issue with great interest and find your proposal for a "Foreign Policy for a World of Decision" most instructive. Concerning NATO, you are probably right that the alliance should focus towards the south and southeast. However, one should not forget that the Baltic states

are, at least for Germany and other states in central and northern Europe, an area of special concern.

What might be lacking in the suggestions are proposals on how to deal with the United Nations. Furthermore, economic issues might be a future area of tension between the United States and Europe as well as Southeast Asia. Is the World Trade Organization adequate to provide solutions? To what degree will the United States abide by them? In my mind, a central question regarding U.S. foreign policy is how America will combine furthering its own national interests with pursuing a multilateral approach.

Helga Haftendorn

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News

In the Age of Information, Can the Great Wall Stand?

China faces a conflict between the modern and the outmoded: how to balance the country's information-related needs with the government's authoritarian policies. During a RAND seminar in September, China expert Nina Hachigian reported trends in that country's attempt to juggle both.

According to Hachigian, a Council on Foreign Relations fellow at the Los Angeles-based Pacific Council on International Policy, 17 million Chinese citizens use the Internet. The typical user tends to be urban, male, single, educated, and young. This year in China, 27,000 new web sites have been created, and about 2 million telephone lines are added every month. The Chinese government

cautiously supports expansion of the Internet for economic growth by sponsoring online contests and offering tax breaks to information technology companies.

Still, Hachigian described potential problems that the Internet poses to Chinese authority. For example, dissident material is regularly distributed via e-mail. Although state control over the Internet is diminishing, the Chinese government still attempts to exert control by blocking sites and enforcing censorship regulations.

The government has also shut down several pro-democracy web sites. It recognizes that the Internet has created a shift in communication, allowing people to speak en masse, which could potentially foster hostility toward the government.



PHOTO BY DIANE BALDWIN

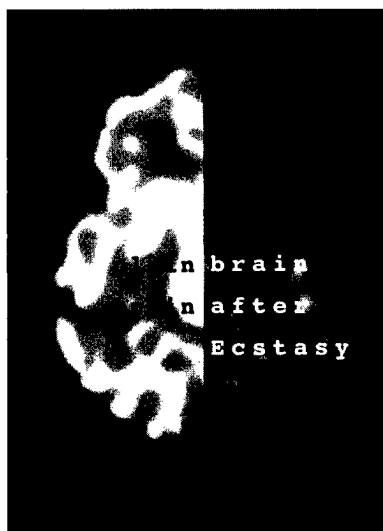
Most likely, anything the United States might do to influence the Internet in China would be considered imperialism, said Hachigian. She suggested that an effective vehicle for developing China's Internet along international standards would be the creation of an international nongovernmental forum where China's regulation of the Internet could be discussed.

Nina Hachigian, right, discusses the rise of the Internet in China. At left is Rachel Swanger, acting director of RAND's Center for Asia-Pacific Policy.

This Really Is Your Brain on Drugs, Scientist Explains

How does an occasional drug user become a drug addict? The answer is in the brain, according to Alan Leshner, director of the National Institute on Drug Abuse at the National Institutes of Health. Speaking to an audience of RAND researchers in October, Leshner described new science that elucidates the physiological nature of drug abuse and addiction.

Just as people don't start out intending to get lung cancer when they smoke, or to get clogged arteries when they eat fatty foods, people don't intend to become drug addicts when they first use drugs.



This image, a composite of scans taken from the same brain, reveals damage after continued use of a drug called Ecstasy. Alan Leshner explained that continued use of illicit drugs causes structural and functional changes in the brain, potentially sparking compulsive addiction.

SOURCE: "Positron Emission Tomographic Evidence of Toxic Effect of MDMA ('Ecstasy') on Brain Serotonin Neurons in Human Beings," U. D. McCann, Z. Szabo, U. Scheffel, R. F. Dannals, and G. A. Ricaurte, *The Lancet*, Vol. 352, October 31, 1998.

"Initial drug use is a voluntary and therefore a preventable behavior," said Leshner. "However, drug addiction is a disease, a treatable disease that's expressed as a compulsive behavior." According to Leshner, drug addiction is the result of the inexorable, yet undetected, destructive biochemical processes at work.

He demonstrated one example of such biochemical processes by showing brain scan images (see photo). According to Leshner, the images clearly show the difference in brain function for an individual who had never used drugs compared with the same person after having used an illicit drug called Ecstasy (methylenedioxymethamphetamine, or MDMA). The left, brighter half shows active serotonin sites in the brain. Serotonin is a critical neurochemical that regulates mood, emotion, learning, memory, sleep, and pain. The right half reveals areas where serotonin sites are not present at all—even after three weeks drug-free.

While all illicit drugs have idiosyncratic effects on the brain, these drugs also have common effects: They trigger the release of dopamine, a neurotransmitter that is directly involved in the experience of pleasure. In essence, drug addicts are addicted specifically to the dopamine spike that drugs produce in the brain.

"While we haven't yet pinpointed precisely all the triggers for the changes in the brain's structure and function, a vast body of hard evidence shows that it is virtually inevitable that prolonged drug use

will lead to addiction," said Leshner. "From this, we can soundly conclude that drug addiction is a brain disease."

Why, then, does an individual take drugs in the first place? "People use drugs for two dichotomous reasons: to feel good (sensation-seeking) or to feel better (self-medicating)." The sensation seekers, Leshner points out, are looking for a novel or exciting experience. The self-medicating types are attempting to escape life conditions, such as poverty or untreated mental disorders, using drugs as if they were treating anxiety or depression.

Whatever the initial reason for using drugs, the vast majority of people addicted to drugs cannot stop. "The reason for this is that prolonged drug use changes the brain in fundamental and long-lasting ways. In some sense, the brain is actually rewired as a function of drug use."

Leshner emphasized that addiction comes from drug use—not drugs—in a way that is not obvious. There is something unique about administering drugs to oneself. For example, when doctors give morphine for pain, patients do not become addicted. Although patients may develop physical dependence on morphine in this case, the compulsion to abuse morphine does not become manifest—and the compulsion is the essence of addiction.

The upshot for policymakers? According to Leshner, the notion that drug addiction is a character flaw—that those addicted to drugs

are just too weak to quit on their own—flies in the face of scientific evidence. Therefore, that notion should be discarded. Instead, attention should be focused on improving drug treatment systems, similar to those for treating other chronic relapsing conditions like asthma or hypertension.

How Terrorism and Popular Culture Feed One Another

The proliferation of commissions, conferences, and publications about terrorism makes it is easy to conclude that the terrorist threat to the United States is on the rise. But that conclusion could just be the result of all the attention, according to Brian Jenkins, a leading RAND expert on terrorism.

Confounding the problem is the influence of popular culture. "Popular culture plays an immense role in threat perception," said Jenkins. Movies, books, television, and lurid newspaper and magazine articles can—and do—influence the public and politicians.

"For example, the president reads a novel about a biological threat. Then he asks his staff if it could actually happen. That's not a casual question when asked by the president."

Suddenly, staffers and experts mobilize to answer the question, some saying maybe yes, others saying maybe no. A commission is convened. A government report is published. Journalists, novelists, and screenwriters then use that report as a basis for further and more dramatic scenarios. Ultimately, what develops is a kind of

"feedback" between politicians and popular culture.

In fact, national security analysts have been known to study what novelists are writing. "Years ago, we did some research on the possibilities of nuclear terrorism," said Jenkins. "One of the tasks was to track all of the nuclear terrorist novels. We wanted to know how well informed they were technically, what their operational schemes were, what problems nuclear terrorists would confront, and how the novelist solved those problems.

"What it really shows is that people get frightened," he continued. Real or not, a perceived threat could promote panic or provoke individuals in positions of authority to react inappropriately.

Popular culture encourages speculation about worst-case scenarios. "In the 1990s, these scenarios, this kind of speculation, has moved from the outer edge of work on terrorism into the mainstream of terrorist threat assessment."

The process begins with someone identifying a hypothetical possibility. With time and debate, the possibility gets legitimized, then becomes a probability, then becomes an inevitability, and finally the threat seems imminent.

"One can always identify a vulnerability, conjure up an enemy, describe catastrophic consequences, and then avoid them by taking the right measures," said Jenkins. "We never know, in fact, if there was a threat to begin with. It's circular and self-contained. And I think that's pretty dangerous as well."



PHOTO BY DIANE BALDWIN

Brian Jenkins describes the "feedback" loop between terrorism and popular culture.

The way that analysts forecast the terrorist threat is changing, Jenkins concluded. "Traditional analysis breaks down, because it doesn't tell us about the rare events we're looking for."

Today, analysts are moving away from the process of identifying potential enemies and toward focusing on domestic vulnerabilities such as water, gas, power, or air navigation systems. "The problem," cautioned Jenkins, "is that the vulnerabilities are infinite."

"One can always identify a vulnerability, conjure up an enemy, describe catastrophic consequences, and then avoid them by taking the right measures. We never know, in fact, if there was a threat to begin with."

—Brian Jenkins

Tranquilizing Effect

To Prevent Youth Violence, Try a Dose of Stability,
A Shot of Self-Esteem, or Some Good Pediatric Advice

U.S. Surgeon General David Satcher is expected to release a major report by the end of the year on strategies for treating violence as a disease—an approach he has long advocated. The report should reinforce the work of researchers across the country who, for the past decade, have been trying to understand youth violence as an epidemic—as a “contagion” that flourishes among susceptible individuals under specific conditions.

Rather than treating youth violence as a criminal matter, which implies punitive solutions, these researchers are treating youth violence as a public health matter, which implies preventive or treatment-oriented solutions. The researchers believe there are acute risk

venting youth violence, even as overall crime rates continued to decline from their peaks in the early 1990s. The most recent indications suggest that crime rates may have bottomed out in major U.S. cities, though, and some observers worry that crime will again rise along with the growing youth population. During the most recent U.S. murder spree, between 1985 and 1991, homicide rates actually fell among people over 25 but more than doubled among those under 18.

Researchers from RAND and the University of California, Los Angeles, have begun to explore the implications of viewing youth violence through the magnifying glass of public health. Phyllis Ellickson, a behavioral scientist, tracked 4,500 adolescents in California and Oregon from seventh grade through high school. She identified some likely risk factors and early warning signs of youth violence. Some of these were strongly correlated with violence among all youth. Others were uniquely correlated with violence among only boys or only girls.

Mark Schuster, a pediatrician, led a study estimating the prevalence nationwide of another possible trigger of youth violence: unlocked firearms in homes with children. Schuster believes that the public health and medical communities can reduce the easy access that many children have to firearms.

Other UCLA and RAND researchers have detected a puzzling resistance by many clinicians to follow existing clinical guidelines to counsel their patients on firearm safety. This resistance occurs at the same time that researchers are discovering new opportunities for clinicians to prevent youth violence.

Diagnosing the Risks

Ellickson and other researchers sifted through 22 potential risk factors for violence among the California

Allegra Alcott, 7, and Gus Geter, 10, lead a First Monday march over New York's Brooklyn Bridge on Monday, Oct. 2., the start of a two-year anti-gun violence campaign scheduled for 50 U.S. cities. The campaign is named after the first Monday in October, when the Supreme Court begins its term.



AP/WIDE WORLD PHOTOS/ROBERT MECEA

factors associated with youth violence. Among these are drug use, family disruption, and antisocial peer groups. Different people could be susceptible to different risks. But if the most virulent risks can be identified, then perhaps people can be inoculated against them.

The massacre at Columbine High School in Colorado last year focused the national agenda on pre-

Correlates of Violence Differ Between Adolescent Boys and Girls

RISK FACTORS FOR VIOLENCE AMONG OLDER ADOLESCENTS

Risk Factors in 12th Grade (and their odds ratios ^a)	BOYS		GIRLS	
	Relational ^b	Predatory ^c	Relational	Predatory
Demographic Risk Factors				
Not living with both parents			1.4	
Behavioral Risk Factors				
Nonviolent felony	1.8	2.9	2.3	2.0
Nonviolent minor delinquency	2.3	4.0	2.4	3.1
Drug selling	2.1	1.7	2.8	3.6
Problem drug use	1.3	1.6		1.8
Early drug use	1.2	1.2		
Full-time work	1.6			
Environmental Risk Factors				
Low academic orientation ^d		1.6	1.5	1.8
Low perceived parental support	1.3	1.3	2.1	1.7
High perceived parental drug use			1.4	1.5
High perceived peer drug use			1.4	
Negative Family Events				
Recent separation/divorce				1.6
Death of parent				2.3
Parental job loss			1.5	

EARLY PREDICTORS OF VIOLENCE AMONG OLDER ADOLESCENTS

Predictors in 7th Grade (and their odds ratios)	BOYS		GIRLS	
	Relational	Predatory	Relational	Predatory
Deviant behavior	1.3	1.7	1.4	1.8
Poor grades		1.5	1.4	
High mobility in elementary school	1.2			
Drug offers	1.3			
Low self-esteem			1.2	
Higher neighborhood SES ^e			0.8	0.7

SOURCES: Saner and Ellickson, 1996; and Ellickson and McGuigan, 2000.

^a Odds ratios appear for each significant risk factor for each gender. For example, the odds of committing relational violence are 1.4 times higher for girls who do not live with both biological parents than for other girls, and the odds of committing predatory violence are 4 times higher for boys who engage in nonviolent minor delinquency than for other boys.

^b Relational violence refers to three or more instances of hitting or threatening to hit family members or acquaintances.

^c Predatory violence refers to any occurrence in the past year of gang fights, strong-arm methods, carrying a hidden weapon, or attacking with intent to hurt or kill.

^d As measured by poor grades and negative attitudes toward school.

^e Socioeconomic status measured by median family income, average education of adults, and percent of families with both parents present.

and Oregon youth. The researchers concluded that violence committed by older adolescents—either high school seniors or high school dropouts—had been correlated with several demographic, environmental, and behavioral risk factors plus some types of family trauma (see upper part of table). The researchers also found that the risk factors were cumulative: As the number of risk factors increased, so did the likelihood of violent behavior. Conversely, there appeared to be no single source of youth violence. “The sheer quantity of risk factors, rather than any specific combination,

predisposes adolescents to violence,” say the researchers.

The most potent demographic risk factor was not really controllable at all: being male. The odds of committing “relational” violence, or persistent hitting of family members or acquaintances, were 1.6 times higher for teenage boys than for teenage girls. Similarly, the odds of committing “predatory” violence—which includes fighting in gangs, using strong-arm methods to get money or things from people, carrying a hidden weapon other than a pocket knife, or attacking

someone with the intent to hurt or kill—were 3.5 times higher for boys than girls. (Because the risk factor of being male cannot apply to girls, it does not appear in the table, which compares youth with peers of the same gender.)

The only other notable demographic risk factor was the absence of one or both biological parents from the home. This factor proved significant only for girls. As shown in the table, the odds of committing relational violence were 1.4 times higher for girls who

did not live with both biological parents than for *other girls*. Other demographic variables—family income, parental education, and multiple moves during high school—fell out of contention in the researchers' mathematical model.

Behavioral risk factors were the strongest and most consistent. Three types of behavior were highly correlated with all forms of violence for boys and girls alike: (1) selling

drugs, (2) committing nonviolent felonies (such as auto theft, arson, or breaking into a home or school), and (3) committing acts of nonviolent minor delinquency (such as minor theft, public disorder, begging, obscene phone calls, joyriding, shoplifting, truancy, and running away from home overnight). These three types of behavior were also the most significant risk factors for violence among boys.

Differences between boys and girls were most prominent regarding environmental risk factors and negative family events. Both genders appeared susceptible to violence given a "low academic orientation," as measured by poor grades and negative attitudes toward school. Both genders also appeared susceptible to violence given a lack of parental affection or support. But girls were especially vulnerable to parental inattention and uniquely vulnerable to parental drug use, parental job loss, parental death, parental separation or divorce, and peer drug use.

Teenage boys and girls who did become violent also tended to exhibit different related problems. Comparatively more violent girls than violent boys suffered from poor mental health, became a parent, or dropped out of school. All of these problems were likely to further damage the girls' personal relationships and

life chances. In contrast, comparatively more violent boys than violent girls sold drugs and committed felonies, behaviors that were likely to damage the larger society in addition to putting the boys at risk of arrest. In these ways, violent girls tended to be more likely to hurt themselves, whereas violent boys tended to be more likely to hurt others.

The sometimes overlapping yet sometimes distinctive risk factors for teenage boys and girls complicate efforts to prevent youth violence. On the one hand, the strong links between drug involvement, other forms of delinquency, and youth violence argue for programs that take into account the clustering of these behaviors among all youth. But addressing many different problems all at once often tends to have little effect, researchers warn. In particular, programs such as group homes that gather problem adolescents together often merely strengthen the deviant behaviors that adolescents learn from one another. One promising alternative to such group homes is "therapeutic foster care," a form of closely supervised foster parenting with round-the-clock professional backup. The Oregon Social Learning Center has found this approach to be effective.

On the other hand, teenage girls with a unique vulnerability to family disruption present unique needs. "Programs for violent girls alone would have somewhat different emphases than programs aimed solely at violent boys," explains Ellickson. A violence-prone teenage girl may benefit from general efforts to curb deviant behavior as well as from specific efforts to strengthen bonds with her own family and school. "But changing these institutions is a particularly difficult task requiring sustained efforts over time," Ellickson says. Even more worrisome for girls, "the association between violence, early parenthood, and poor mental health raises serious concerns about the nature of the parenting and the environment such girls are likely to give their children."

Detecting Early Warning Signs

Daunted by the difficulties of preventing or stopping violence among teenagers already at risk, researchers have begun to suggest strategies to keep adolescents from experiencing too many risk factors in the first place. These strategies target the early warning signs of potential violence in an attempt to nip them in the bud before they metastasize out of control, comparable to targeting the earliest signs of cancer.

**Violent girls tended
to be more likely
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whereas violent
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Among the California and Oregon teens in her study, Ellickson detected warning signs in seventh grade that predicted violent behavior five years later. As with the risk factors measured during high school, the predictors apparent as early as seventh grade applied sometimes to all youth but other times only to boys or girls (see lower part of table).

Two early predictors of violence applied to boys and girls alike: deviant behavior and poor grades. Deviant behavior in the seventh grade consisted of stealing, skipping school, cheating on tests, or being sent out of class. Seventh graders involved in these activities were significantly more likely to become violent five years later than those not involved in these activities. Poor grades in middle school also foretold violent times ahead for both genders.

Two early predictors applied to seventh-grade boys only: drug offers and high mobility during elementary school. Boys were uniquely vulnerable to repeated offers of drugs from their seventh-grade peers and to repeated moves that had involved shifting from one elementary school to another. Both conditions predicted future relational violence for boys but not girls.

Seventh-grade girls, on the other hand, were uniquely susceptible to low self-esteem and to living in neighborhoods of low socioeconomic status. Girls who exhibited low self-esteem in seventh grade were more likely to engage in relational violence five years later. Girls who attended schools in poor neighborhoods were more likely to commit both relational and predatory violence later on. Neither predictor applied to seventh-grade boys.

Ellickson found one additional early predictor of violence: attending a middle school with high levels of cigarette and marijuana use. Such middle schools appeared to foster overall violence among boys and girls alike but did not predict the specific forms of relational and predatory violence. (Therefore, this predictor does not appear in the table.) Other variables not studied by RAND were family violence and low parental supervision, both of which have been linked with later violence among children.

Little in the RAND study argued for differential violence prevention efforts by race, ethnicity, or social class. Most of the relationships between violence and these demographic categories disappeared when behavioral and environmental factors were taken into account. The differences between boys and girls,



AP/WIDE WORLD PHOTOS/THE ENTERPRISE JOURNAL/AARON RHODS

however, were highly significant as early as the seventh grade. "Violence prevention efforts should be sensitive to the special needs of both sexes," concluded Ellickson, "particularly the higher-risk profiles of girls with low self-esteem and of boys who have experienced substantial discontinuity in their early school environment."

For boys, the additional link between early exposure to drug offers and subsequent violence suggests the need for extra training to help boys resist social pressures to use drugs. For boys alone, the greater the frequency of drug offers in middle school, the greater the likelihood of committing relational violence down the road. Therefore, programs to prevent drug use in middle school might yield the added benefit of reduced violence among males several years later. Furthermore, because middle schools with high rates of actual drug use also appear to foster later violence among boys and girls alike, reducing overall levels of drug use in these middle schools could also reduce overall levels of violence several years later.

Of course, violence prevention efforts should also target the two strongest and most common early warning signs of violence among seventh graders: early deviance and poor grades. Because troublesome behavior and poor grades appear at least as early as the sixth grade and probably even earlier, some prevention efforts need to begin in elementary school.

Local residents Jeremy Roberts, left, and Ben Legg look over four of the crosses put on display at East McComb Baptist Church in McComb, Miss., in September. The crosses, erected in Littleton, Colo., in memory of the victims of the Columbine High School shooting spree, came to McComb as part of a tour to discourage youth drug use and violence.

Two early predictors of violence applied to boys and girls alike: deviant behavior and poor grades.

Triggers of Disease

Although debate over gun control has intensified in the wake of school shootings nationwide, there has been a fair amount of consensus that firearms should be inaccessible to children. The American Academy of Pediatrics (AAP) and the National Association of Pediatric Nurse Associates and Practitioners (NAPNAP) recommend that parents remove firearms from homes with children. If the firearms are not removed from these homes, then the AAP recommends, at the very least, that parents store the firearms locked, unloaded, and separate from locked ammunition. The Sporting Arms and Ammunition Manufacturers' Institute also recommends storing firearms and ammunition secured in a safe place, separate from each other. And the National Rifle Association recommends storing firearms unloaded and inaccessible to children.

Unfortunately, practice does not square with principle. There are 11 million homes in the United States with children and firearms. These homes account for a third of the country's children—or more than 22 million children. However, just 39 percent of these homes store their firearms locked, unloaded, and separate from ammunition, according to Mark Schuster, of RAND and UCLA.

In contrast, 9 percent of all homes with children and firearms keep firearms unlocked (either in an unlocked place or with no trigger lock or other locking mechanism) and loaded, while another 4 percent keep firearms unlocked and unloaded but stored with

ammunition. Thus, a total of 13 percent of homes with children and firearms—accounting for 1.4 million homes with 2.6 million children—store firearms in a manner that makes them most accessible to children (see pie chart).

Although it is ultimately the responsibility of parents and other adults to ensure proper storage and usage of firearms among children, Schuster believes that physicians can help adults reduce the dangers. The American Medical Association (AMA) advises physicians to ask if patients or their families own a gun, to educate them about the dangers of guns in the home, and to inform them how to store guns safely. The AAP offers physicians a self-training program that goes into greater detail: Physicians can obtain a history of family exposure to violence, teach parents and children about nonviolent problem-solving techniques, review firearm risks and safety, and reinforce ongoing efforts to reduce violence.

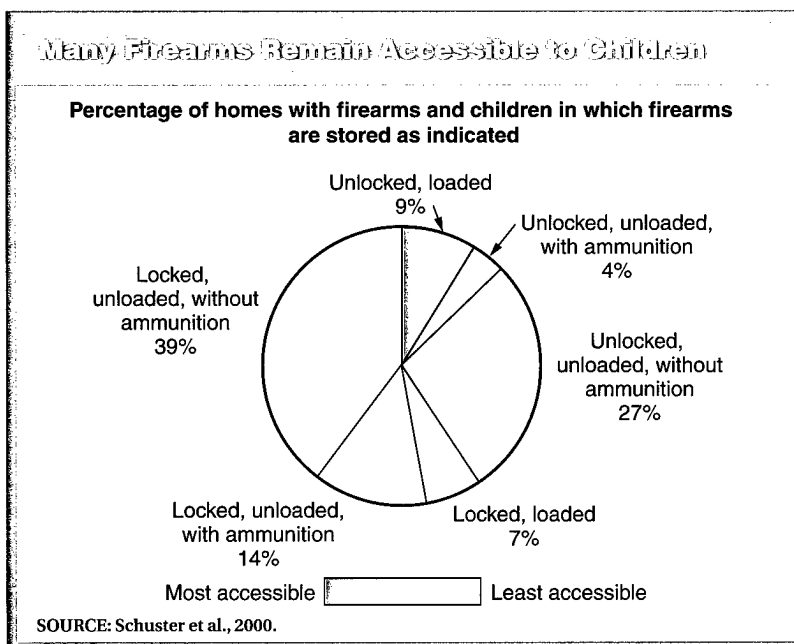
The Role of Pediatricians

Many clinicians fail to provide firearm safety counseling, even when they know they should. That is the troubling conclusion of a RAND and UCLA research team led by Shari Barkin, a pediatrician from the UCLA School of Public Health.

The team surveyed 465 pediatricians, family physicians, and pediatric nurse practitioners serving families with children aged five years and younger in Los Angeles County. Of the 325 clinicians who responded, 70 percent said counseling on firearm safety would be beneficial. However, only 38 percent said they provided such counseling. Of those who did, only 20 percent counseled more than 10 percent of their clientele.

Many clinicians said they would be more likely to provide counseling if more educational materials were available to them. But materials have already been made available; in 1994, for example, the AAP sent materials to all its members. Likewise, about a quarter of the clinicians said an endorsement of firearm safety counseling from major medical organizations would increase the likelihood of their providing counseling. But the AMA, AAP, NAPNAP, and the American Association of Family Physicians already provide endorsements. Still, few clinicians offer counseling.

Worse yet, some who do offer counseling contradict the clinical guidelines. As noted above, the AAP and NAPNAP prefer that firearms be removed from homes with children. The AAP also recommends that if



a household does not already have a gun, clinicians should discourage families from purchasing one. Once again, however, practice does not square with principle. In the survey, 22 percent of the clinicians reported owning a firearm themselves. Of these clinicians, 30 percent advised parents that "children in families that keep firearms should be taught how to use them safely when they are old enough." Clinicians who owned guns were also among the most likely clinicians to offer counseling. It is clear that something else besides unfamiliarity with guidelines or unavailability of materials impedes routine and proper firearm safety counseling by pediatric providers.

"Considering the amount of gun violence in our society," Barkin concludes, "it is appropriate to conduct a clinical trial of efforts to increase counseling about firearm safety in primary care, to test experimentally the effects of such counseling on parental knowledge and behavior, and to evaluate the effects on their children."

Meanwhile, pediatricians can do plenty to prevent youth violence, according to another study led by Barkin. First, they should continue counseling parents about gun safety. Second, they can educate children and teenagers directly about choices they can make to stay safe. Third, they can refer families to community resources, especially to clubs that offer young people the chance to interact with positive peer groups and strong adult mentors. Pediatricians alone cannot solve the problem of youth violence. But pediatricians, parents, and community leaders can work together as important links in the chain of youth violence prevention, according to the study.

In summary, researchers have only begun to suggest potential antidotes to youth violence:

- For older adolescents with a history of violence and obviously troubled behavior, therapeutic foster care looks promising. For older boys and girls at heightened *risk* of committing violence, more research is needed to identify successful interventions targeted at multiple problems.
- Reducing overall levels of drug use in middle schools could reduce overall levels of violence later on.
- Younger adolescent boys might benefit from fewer moves during elementary school and from more training during middle school to help them resist peer pressure to use drugs. Younger

adolescent girls might benefit from efforts to boost self-esteem. But poor grades and early acts of deviance often precede adolescence, requiring help at an earlier age.

- Pediatricians and other clinicians can do more to educate families about gun safety and to refer young people to community resources.

The field of violence epidemiology is still in its infancy. Continued cooperation among researchers, clinicians, and community leaders will be necessary to ensure that the public health approach to youth violence can eventually yield early prescriptions to help young people avoid the later quarantine of incarceration. ■

Related Reading

"African American Mothers in South Central Los Angeles: Their Fears for Their Newborn's Future," *Archives of Pediatrics & Adolescent Medicine*, Vol. 152, March 1998, pp. 264-268, Mark A. Schuster, Neal Halfon, David L. Wood. Also available as RAND/RP-705, no charge.

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"Early Predictors of Adolescent Violence," *American Journal of Public Health*, Vol. 90, No. 4, April 2000, pp. 566-572, Phyllis L. Ellickson, Kimberly A. McGuigan.

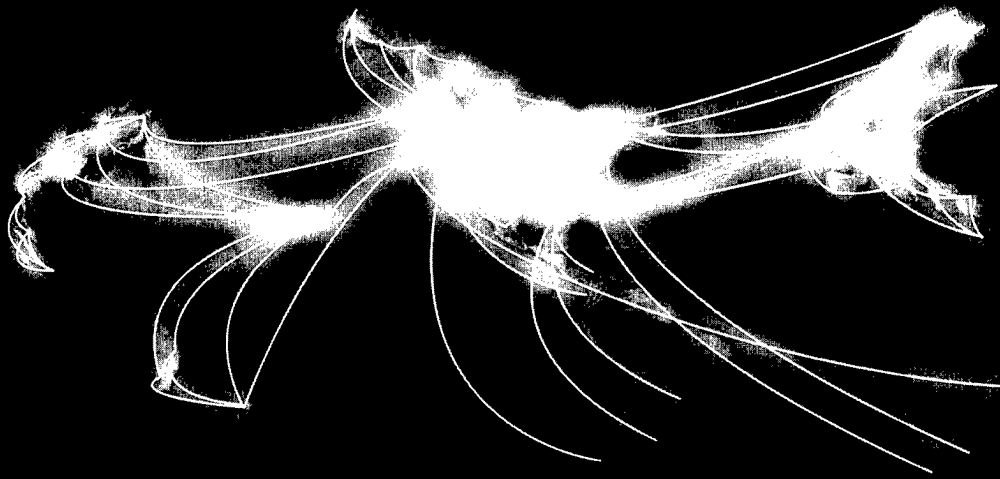
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Many clinicians fail to provide firearm safety counseling, even when they know they should.



World Wide Web traffic emanates predominantly from the United States and Canada. RAND researchers say the information revolution is fostering a global "realm of the mind" that could form the backbone of an American information strategy.

ILLUSTRATION BY PETER SORIANO

Transcendental Destination

Where Will the Information Revolution Lead?

Twenty years from now, by the year 2020, the information revolution will have altered life on this planet even more dramatically than in the last 20 years, according to the experts. Even if they hesitate to specify exactly what the technological changes might be over the next two decades, the experts offer even more intriguing insights into how those technological changes could, in turn, change us as people, as nations, and as a global web of human thought and action.

With regard to technological breakthroughs, the fear of forecasting the future is forgivable. Back in 1980, a mere 20 years ago, almost no one could have predicted the explosive growth of the World Wide Web. The Arpanet was then the U.S. defense department's precursor of the Internet, which later did lead to the emergence of the World Wide Web. But in 1980 there

was still no hypertext language for navigating from web site to web site, still no graphical interface, nothing like today's chat rooms, no laptop computers, and no cell phones, let alone cell phones that could deliver e-mail via satellite. Conversely, predictions that once seemed reasonable now appear naïve in retrospect. It's already the year 2000, for example, but cars still can't fly.

With regard to overall technological trends, on the other hand, efforts to anticipate the future are more than exercises in futility. While it is risky to predict the future in detail, it may be even more foolish not to prepare for it at all, especially when the future promises to bring changes as swift and pervasive as those made possible by the information revolution.

Consequently, several U.S. government agencies have asked RAND to take the lead in broadly outlining

what may lie ahead and boldly deducing the implications for government and society. The work has proceeded on three fronts: (1) to chart the future course of the information revolution throughout the world over the next 10–20 years, (2) to identify potential forms of global governance that might become necessary as a result, and (3) to suggest a national “information strategy” appropriate for a global information age. The research sponsors include the National Intelligence Council, a small center of strategic thinking within the U.S. intelligence community; the Defense Advanced Research Projects Agency, which created the original Arpanet in 1969; the White House Office of Science and Technology Policy; and the Office of the Secretary of Defense. Although the three strands of research have proceeded independently of one another, they build on each other in compelling ways.

To chart the future course of the information revolution, a team of researchers led by Richard Hundley has initiated a series of international conferences of leading computer scientists, defense planners, and policy analysts. One conference, devoted to technological trends, looked beyond Moore’s Law—the expected doubling of the density of integrated circuits on a silicon chip every 18 months or so—to envision the likely effects of information technology on various countries, regions, and cultures. Another conference considered the political, economic, and social consequences already affecting many parts of the world. Subsequent conferences will chart the course of the revolution in greater detail in Latin America, Europe, and Asia. The participants already agree that the information revolution will affect all nations, albeit in different ways.

To identify forms of global governance that might be necessary for the information age, Francis Fukuyama and Caroline Wagner highlighted three models of political and social organization that could complement the nation-state: distributed decisionmaking, citizen councils, and nongovernmental organizations. These models function not as hierarchical systems of control; rather, they involve broader swaths of the body politic in transnational deliberations. This attribute will be critical for any new system of governance to be effective, the researchers conclude.

To suggest an American information strategy for the 21st century, John Arquilla and David Ronfeldt drew inspiration from the prophetic writings of a French soldier, paleontologist, and Jesuit theologian of the early 20th century, Pierre Teilhard de Chardin (TAY-

yar DUH Shar-DAN). The controversial writings of Teilhard during World War I and the 1920s were censored by the Vatican but published posthumously in the 1950s and 1960s. He asserted that evolution and Christianity, far from being at odds with each other, are in fact part of the same process: the evolution of a benign spiritual force through increasingly complex forms of material life on earth. Teilhard foresaw that human beings would rise to a new evolutionary plane characterized by the global coordination of intellectual, social, and spiritual energies. He called this higher plane the “noosphere” (NEW-oh-sphere), defining it as an all-encompassing realm of the mind (from the Greek *noos*, or “mind”). Teilhard predicted that this realm would eventually supersede the prior evolutionary realms of the geosphere and the biosphere as the supreme milieu of the spirit on earth. Today, Teilhard is occasionally credited with anticipating the Internet.

The all-encompassing realm of the mind, though intangible by definition, forms the backbone of the American information strategy proposed by Arquilla and Ronfeldt. They advance the notion of “noopolitik” (NEW-oh-poh-li-TEEK) as a new form of statecraft for the information age. As opposed to realpolitik, which often refers to a policy of national expansion across geographic terrain, noopolitik would seek instead to advance national ideas, values, laws, and ethics across the “psychic terrain” of the noosphere that envelops the planet. Noopolitik represents an evolutionary leap in statecraft made possible by the information revolution.

RAND researchers foresee that the information revolution will change not just the way people behave thanks to new technological devices, but, more essentially, the way people understand and organize themselves—socially, culturally, politically, economically, governmentally, militarily, and even spiritually. Similarly, the information revolution will transform the way nations behave and understand their roles in the world. These changes ought to be the most pronounced in the United States, the researchers aver. As the global leader of the information revolution, the United States should begin now to redefine its purpose in the world, to redesign its national institutions, and to update its national strategies in ways that befit the revolution it has wrought.

Teilhard foresaw that human beings would rise to a new evolutionary plane.

The Future of the Revolution

The first two conferences organized by RAND to chart the likely course of the information revolution each convened about 40 participants. Most came from the United States. Others came from Australia, Britain, Denmark, France, India, Japan, and Russia. The next

A visitor tests a wearable, wireless Internet device, called the "Charmed Communicator," on display at the China Internet World 2000 exhibition in Beijing in April. The device can be used for computer games, as a web browser, as an e-mail terminal, or as a replacement for a desktop computer.



AP/WIDE WORLD PHOTOS/GREG BAKER

three conferences in this series will broaden and deepen RAND's understanding of the worldwide course of the information revolution as it pertains specifically to Latin America, Europe, and the Asia Pacific region.

So far, the participants have agreed on the basics: Over the next 15–20 years, computing will get faster and cheaper, communications bandwidth (or capacity) will increase enormously, and interesting new devices will emerge. As a result, the industrialized countries could expect to encounter a plethora of new technological phenomena, particularly in five areas:

1. *Photonics.* Optical transmission lines, amplifiers, and switches will allow a tremendous increase in the bandwidth of packet-switching technology. This will lead to major changes in computer architectures, operating systems, and networking protocols. Many present-day leaders in the computer and communications industries will be threatened with extinction.

**Computers will be everywhere.
Sensors will be everywhere as well.**

2. *Universal connectivity.* Wireless communications will provide seamless data, voice, and video services to anyone anywhere on earth at any time of the

day or night. This will have a huge affect on business practices, international financial institutions, and governments.

3. *Ubiquitous computing.* Computers will be everywhere: in smart home appliances, smart houses, smart offices, smart buildings, smart cars, and smart highways. Smart appliances, for example, could "talk" to one another and sense the presence of humans. Wearable and implanted computers will give people constant access to information services while mobile.

4. *Pervasive sensors.* Sensors will be everywhere as well. Wireless sensors will include tiny video cameras, tiny microphones, accelerometers, gyroscopes, Global Positioning System receivers, smell sensors, food sensors, biosensors, and polymer-based sensors. They will provide directions, identify spoiled food, detect diseases, detect natural and synthetic compounds, and assist police and the military with instant feedback on individual or group activities. Privacy issues will continue to mount and will demand solutions.

5. *Global information utilities.* It will be possible to plug information appliances into wall sockets connected to public information utilities in much the same way as we now plug electrical appliances into sockets connected to electrical utilities. Just as we obtain electricity, gas, water, and telephone services from wires and pipes to our homes, so will we be able to obtain information services.

Today, however, high-speed Internet connections exist almost exclusively between the United States and Europe and between the United States and Asia. There are very few high-speed links to or among developing countries. About half of all Internet users reside in the United States and Canada.

Further disparities between industrialized and developing nations could arise in several areas, including health care, education, and commercial supply-chain management.

In health care, "telemedicine" will allow remote diagnoses, remote monitoring of vital signs, and easy transfer of electronic medical records (all of which will require high degrees of security). Telemedicine will probably widen the gap between rich and poor societies, because only those countries with the requisite infrastructure and bandwidth could exploit the full benefits. Even so, some benefits could accrue to the poor. For example, medical students and doctors in poor countries could get improved information and training over the web. And countries short of doctors

could reap huge gains from equipment now being designed by the U.S. military. For example, a "smart stretcher" could transmit detailed information about an injured soldier (or civilian) to remote physicians, who could then instruct a medic at the scene to follow specific procedures.

In education, the greatest benefits will probably go to adults who pursue lifetime learning, specialized training, or postgraduate education through "distance learning." Again, the need for an infrastructure would favor wealthy nations the most, but the opportunity for remote access to superior teachers and educational materials could also benefit people of poor nations.

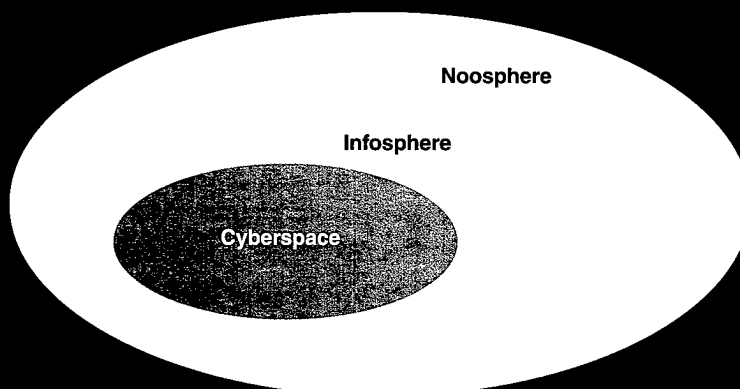
Supply-chain management refers to the effort by businesses and manufacturers to reduce surplus inventories wherever possible and thus cut costs. New computerized management systems already have led to vast improvements in tracking inventories, reducing overhead costs, and allowing managers to understand intuitively the workings of very complex production systems. These kinds of improvements reduce the advantages that accrue to cheap laborers (those who produce and store surplus inventories) and thus could end the flight of manufacturing to the developing world. This could have profound consequences for the global distribution of income.

The conferees expressed additional misgivings. The information revolution, they suspect, will widen the economic, social, and political disparities within societies as well as among nations. Privacy will be increasingly jeopardized. The spread of U.S. culture could overwhelm other cultures. And nations will pay an increasing price for going their own ways.

But the revolution cannot be stopped, the conferees concluded. For better or worse, it is leading to a future that will be characterized by many interrelated economic, social, and political features:

- the continuing rise of electronic commerce and the elimination of myriad "middlemen," creating greater efficiencies but also greater possibilities for social exclusion
- a growing fraction of economic activity performed by "information workers"

Three Realms of Information



To devise an effective American information strategy, it is essential to understand that cyberspace is just the tip of the informational iceberg. Cyberspace refers to the global network of computers, communications infrastructures, databases, information utilities, and online conferencing services generally known collectively as the Internet. Larger than cyberspace is what John Arquilla and David Ronfeldt call the infosphere. The infosphere includes cyberspace plus all other information resources—such as broadcast media, print media, and public libraries—portions of which are not yet available electronically. Larger still is the noosphere, which incorporates both cyberspace and the infosphere, plus all other educational resources and civilizational wisdom, into an ethereal, globe-spanning realm of the mind—a sort of planetary "consciousness." Further distinctions between these three realms of information appear below. These distinctions are important, because an effective American information strategy would confine itself neither to cyberspace nor to the infosphere; rather, it would target the noosphere.

Technologies, Organizations, and Ideas That Distinguish Each Realm of Information

	Cyberspace	Infosphere	Noosphere
Technologies	<ul style="list-style-type: none"> • Internet • World Wide Web 	<ul style="list-style-type: none"> • Radio • Television • Cable channels 	<ul style="list-style-type: none"> • All systems of education and training
Organizations	<ul style="list-style-type: none"> • Electronic Freedom Foundation • Computer Professionals for Social Responsibility 	<ul style="list-style-type: none"> • Disney • Time-Warner • CNN 	<ul style="list-style-type: none"> • Transnational nongovernmental organizations • Universities • United Nations
Ideas	<ul style="list-style-type: none"> • Interconnectivity • Democracy 	<ul style="list-style-type: none"> • Interdependence • Prosperity 	<ul style="list-style-type: none"> • Sharing ideas • Civility

SOURCE: Arquilla and Ronfeldt, 1999.

- flatter, less-hierarchical business organizations that place a higher value on social networks and informal communications
- challenges to the power and authority of the nation-state as a result of many factors, including the increasing porosity of national borders and the simultaneous assemblage of a wide variety of interest groups that operate largely beyond the control of individual nations
- new fault lines within and between nations, by virtue of the widening gulfs between the educated, wealthy, and “wired” of all nations and the less fortunate of all nations
- many new winners and many new losers among individuals, groups, nations, and regions.

The Direction of Governance

Of particular concern to the U.S. government, naturally, is how to govern the new technologies—or, in other words, how to control, direct, shape, or regulate their use. In an age of globally networked information systems that could be used for good or ill by any user, it is not yet clear what kinds of governmental decisionmaking structures should or could be put into place. Whereas the industrial revolution generated large-scale technologies (telecommunications, airlines, nuclear energy) whose control required centralized

nist states of East Germany and the Soviet Union as well as the right-wing dictatorship of Ferdinand Marcos in the Philippines. In the future, the information revolution could help to open other closed societies such as China, whose government has tried to control Internet use for political reasons.

Americans also have selfish reasons for wanting to spread the revolution around the world with few constraints. Americans stand to benefit economically. American companies dominate the global information industry. American media and cultural products, from CNN to Disney to MTV, will be disseminated via the new technological innovations. American media will also foster American values, both political and cultural, as the world becomes more electronically connected. It is natural for Americans to argue for minimal government regulation of information technologies, for that would appear to favor American interests and values around the world.

But the Internet poses real problems for America as well. The Internet has evolved well beyond its original function of sharing information into a global commercial trading system. Electronic commerce has strained international trade agreements, jurisdictional powers over taxation and regulation, and legal safeguards for intellectual property. The borderless nature of electronic commerce has also extended the reach of criminal activity. Money launderers, drug traffickers, hate groups, and pornographers rank among the most innovative users. Terrorists have new tools, too. Not only can terrorists organize across international borders, they can also undermine social order by spreading false or misleading information that may be difficult to counteract.

In fact, the Internet could accelerate the fragmentation of civil society itself. In the middle of the 20th century, the mass media gave Americans a common set of cultural experiences, whether through watching the Ed Sullivan Show or reading *Life* magazine. All forms of media today, not just the Internet, target highly specialized niche markets, with 500 cable channels on television and tens of thousands of online discussion groups on the Internet. In aggregate, citizens have fewer and fewer common cultural experiences and points of reference, with possible negative implications for their ability to associate and work together as a national political community.

The solution might be to build an *international* political community, according to Fukuyama and Wag-

To control, shape, and regulate the new technologies will require institutions as borderless and decentralized as the technologies themselves.

decisionmaking by national authorities, the information revolution has produced global technologies whose control resides largely in the hands of individuals. The obstacles to governing such technologies are tremendous.

In fairness, Fukuyama and Wagner recognize that the new technologies have been hailed for supporting the political values championed by the West. Cheap and ubiquitous phones, fax machines, radios, computers, e-mail, and the Internet have all been saluted for helping to overthrow authoritarian powers throughout the world and spread liberal democracy. Modern communications were crucial in undermining the commu-

ner. They do not propose some kind of world government that would weaken U.S. sovereignty. They do, however, recognize that no single nation can govern the new technologies. To control, shape, and regulate them will require institutions as borderless and decentralized as the technologies themselves. Therefore, the researchers propose that the U.S. government work with other governments, organizations, and individuals to create new institutions of governance, as opposed to government. These institutions will need "buy-in" from a wide range of nations, organizations, and average citizens to be considered legitimate and effective. When technology is in the hands of individuals, the only viable regulatory structure will be one endorsed by those individuals themselves.

New governance mechanisms are needed quickly, Fukuyama and Wagner argue. They weigh the possibilities for three existing models of governance: distributed decisionmaking, citizen councils, and nongovernmental organizations (NGOs). All three models have the ingredients of future success: They are nimble, inclusive, decentralized, and global. All three models also have disadvantages.

The first model, decentralized decisionmaking, would require many organizations and users to reach consensus on various matters: what technologies to support with research and development money; what technologies need governance; what the norms of use and application should be; and whether, how, and at what level of formality the technologies should be regulated. Although this process of creating common norms would provide a solid foundation for global governance, it often takes a long time to create common norms. And time, unfortunately, is of the essence.

The second approach would be to create citizen councils that would make recommendations to formal governing bodies. For instance, hundreds of citizen councils could be organized across the United States (or around the world) and encouraged to deliberate over the rules and regulations that should govern information technology. Using the formidable networking capacities of the Internet, these councils could share ideas on a series of questions and point toward a gov-



AP/WIDE WORLD PHOTOS/CHRIS PIZZELLO

Jeff Mallett (left), of Yahoo! Inc., demonstrates the Internet to 10-year-old Juan Martinez (right), 9-year-old Jonathan Bermudez (second from right), and 10-year-old Adrian Solorio, all of Los Angeles, at the Hollenbeck Youth Center in Boyle Heights in July. In back is Todd Wagner, of Broadcast.com, who donated computer hardware and training to help the center bridge the "digital divide."

erning consensus. A centrally organized group—such as the White House Office of Science and Technology Policy, the National Science Foundation, or a public-private coalition—could provide the considerable incentive of coordinated action, could give the councils sufficient information with which to deliberate, and could serve as the clearinghouse for opinions and ideas. Citizen councils like this have been used quite effectively in Europe. However, American culture is less homogeneous than the culture of many a European nation. Citizen councils in America would have to represent the greater diversity of the American people as well as simultaneously accommodate the individualistic nature of U.S. culture.

The third approach would be to promote governance of information technologies by international NGOs. In recent years, numerous NGOs have used electronic communications to achieve outcomes otherwise unattainable by sovereign nation-states. Human rights and other activist groups forced the hand of the Mexican government on behalf of the Indians in Chiapas. Greenpeace and other environmental groups forced Shell Oil to change its policies with respect to the North Sea and Nigeria. Other groups induced the sportswear maker Nike to promise compliance with child labor standards. In each case, NGOs changed the behavior either of a government or of a large multinational corporation when state action had been ineffective. NGOs have the capacity to organize quickly and transnationally in ways that avoid the bureaucracy and rigidity of conventional international institutions.

On the other hand, NGOs are ultimately unaccountable to anyone but their own adherents. Unlike a democratically elected legislature that can be turned out of office, NGOs cannot be removed by popular demand. They lack the legitimacy of formal government institutions that operate by popular consent. Moreover, NGOs usually deal with limited issues in limited ways. NGOs have neither the obligation nor the capability to promote the public interest at large.

The Destiny of America

In their call for a new form of statecraft for the information age, Arquilla and Ronfeldt decry the "imbalance" they now see in efforts to craft an American information strategy. A good strategy would balance two opposite poles, they explain. One pole is techno-

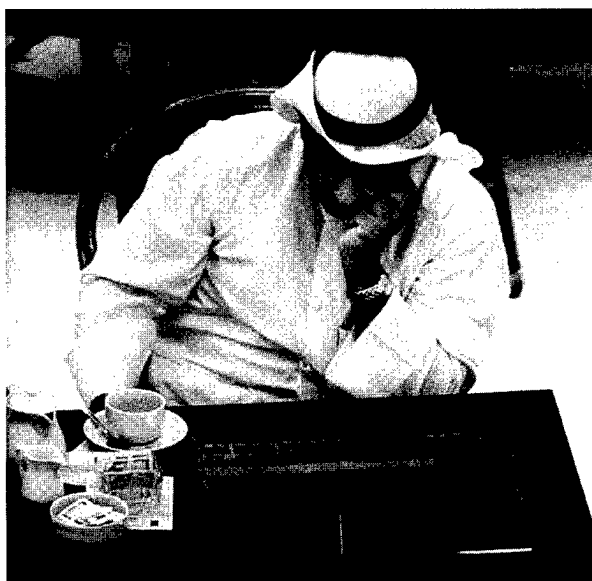
"manifest destiny" of propagating its ideals, values, and ethics around the world.

The original notion of the noosphere, as articulated by Teilhard, was never neutral with respect to values or ethics. He was a priest, after all. In his vision, the higher evolutionary plane of the noosphere would be reached not merely through the coordination of human energies but, more intrinsically, through a devotion to moral and juridical principles. Arquilla and Ronfeldt embrace that idea. They contend that the Internet and other forms of global communication should serve a higher purpose beyond just disseminating information or fueling commerce. Hence, America should harness the new technologies to promote the ideals for which it stands: openness, freedom, democracy, the rule of law, humane behavior, human rights, and a preference for peaceful conflict resolution.

Such an information strategy would be called noopolitik. Unlike realpolitik, which is foreign policy based on raw calculations of power and narrow national interests, noopolitik is foreign policy based on global ideas, values, norms, laws, and ethics. Realpolitik works through the "hard power" of men, missiles, guns, and ships. Noopolitik emphasizes the "soft power" of attraction rather than coercion. Realpolitik asserts that might makes right; noopolitik, that right makes might. Realpolitik tends to be amoral if not immoral. Noopolitik succeeds only by upholding shared principles.

There are immense implications for the U.S. military. To simultaneously disseminate and defend American ideals, the military would need plenty of new capabilities to deal with both friends and foes. On the one hand, the military would need globally interconnected information systems that allow conditional sharing of information with semitrusted allies. On the other hand, the military would need new organizational designs and doctrines for using information-age "swarming" strategies against terrorists, authoritarian regimes, or other adversaries. These swarming strategies would entail striking at foes from many directions simultaneously—sometimes with heat-seeking missiles and other smart munitions, sometimes with truth-seeking teams of "special media forces" armed with the weapons of the media rather than traditional military weapons. The media forces would be dispatched into conflict zones to help settle disputes through the discovery and dissemination of accurate information.

A man in local Arabic dress browses the Internet at a café in Dubai, United Arab Emirates, in August. Arab rulers have slowly, somewhat reluctantly made the Internet available to their people, attempting to filter out free-wheeling political discussion as well as pornography.



AP/WIDE WORLD PHOTOS/KAMRAN JEBREILI

logical—that of ensuring the safety and security of information infrastructures. The other pole is political or ideational—that of harnessing and disseminating American ideals to attract, influence, and lead others.

Both poles are important, but the technological concerns have grabbed the bulk of the attention. Meanwhile, the broader sociopolitical objective of sharing ideas has been neglected. It is time for U.S. civilian and military leaders to look beyond the defense of information infrastructures, say Arquilla and Ronfeldt. There is much more at stake in cyberspace than technological vulnerability. There are also unprecedented opportunities. In other words, beyond merely defending against an "electronic Pearl Harbor," America should endeavor to fulfill a new information-age

For the time being, the leading practitioners of noopolitik are neither nation-states nor their militaries but, as indicated above, NGOs. They are already utilizing information technologies to promote a global civil society. Prime examples include the Nobel prize-winning campaign to ban land mines; the Greenpeace-led campaign against French nuclear testing in the South Pacific; the transnational defense of Zapatista insurgents in Mexico; and the Internet-based efforts by Burmese and Chinese dissidents, with support from NGOs based in the United States, to press for human rights and political reforms. Such efforts suggest that old tenets of "peace through strength" are yielding to new tenets of "peace through knowledge."

An American information strategy of noopolitik would build on the successes of NGOs. Once again, the researchers do not call for some kind of overarching global government. Rather, they explain that the most effective strategy for the U.S. government would be to form a cooperative network with allied governments and NGOs in pursuit of common global missions. At the same time, an American information strategy for the future could not be confined strictly to American interests and institutions. The inherently global nature of modern information and networking would undermine such a narrow strategy. National interests would still play a role, but they would need to be recast in universal terms.

For example, U.S. foreign policy might face widespread global opposition. In this case, U.S. policy itself might need to be reconsidered. This sort of problem has recently occurred. The United States has refused to join more than 100 countries in signing a treaty to ban land mines, mainly because of the U.S. military's reliance on land mines on the Korean peninsula. Yet the United States could reconsider its reliance on land mines, either by shifting to tactics that have little use for land mines or by developing mobile mines that travel with ground troops. Either solution would resolve the impasse, and both could lead to greater U.S. military effectiveness.

There are certainly risks in pursuing a strategy that could place limits on American freedom of action. A vibrant, global civil society built on an interconnected network of NGOs and nation-states might one day curtail the autonomous exercise of American power. Yet if free flows of information do indeed foster democracy and open markets, the overall benefits of such a strategy are likely to exceed the liabilities. In some ways, such a strategy resembles the Marshall Plan that rebuilt Western

Europe and Japan after World War II. The United States used its power to strengthen others against a communist threat, even to the point of creating new economic giants that could rival America's own market power. Similarly, Arquilla and Ronfeldt believe that America stands to benefit, on balance, from the emergence of the noosphere and the pursuit of noopolitik.

At the beginning of this strategy, American hegemony might even be the necessary precondition to consolidate the global noosphere. Much as classic theories of trade openness depend on a benign hegemon to keep markets open and to provide the "public goods" (like freedom of the seas) that make trade possible, a benevolent hegemon may now be required to coordinate a network of NGOs and nation-states as the nucleus of a global civil society. At the end of this strategy, however, American hegemony might indeed fade. But here is the consolation: America would transcend itself on behalf of a greater global good. American ideals, with modest refinements, would write the constitution of a global civil society, even as the American state itself would lose its primacy. That would be a fitting legacy of the primacy of American ideals. ■

America should endeavor to fulfill a new information-age "manifest destiny."

Related Reading

The Emergence of Noopolitik: Toward an American Information Strategy, John Arquilla, David Ronfeldt, RAND/MR-1033-OSD, 1999, 102 pp., ISBN 0-8330-2698-4, \$15.00.

The Global Course of the Information Revolution: Political, Economic, and Social Consequences—Proceedings of an International Conference, Richard O. Hundley, Robert H. Anderson, Tora K. Bikson, James A. Dewar, Jerrold Green, Martin Libicki, C. Richard Neu, RAND/CF-154-NIC, 2000, 142 pp., ISBN 0-8330-2850-2, \$9.00.

The Global Course of the Information Revolution: Technological Trends—Proceedings of an International Conference, Robert H. Anderson, Philip S. Anton, Steven C. Bankes, Tora K. Bikson, Jonathan Caulkins, Peter J. Denning, James A. Dewar, Richard O. Hundley, C. Richard Neu, RAND/CF-157-NIC, 2000, 127 pp., ISBN 0-8330-2906-1, \$9.00.

Information and Biological Revolutions: Global Governance Challenges—Summary of a Study Group, Francis Fukuyama, Caroline S. Wagner, RAND/MR-1139-DARPA, 2000, 140 pp., ISBN 0-8330-2807-3, \$15.00.

Swarming and the Future of Conflict, John Arquilla, David Ronfeldt, RAND/DB-311-OSD, 2000, 107 pp., ISBN 0-8330-2855-5, \$18.00.

Competitive Jolt

For Electricity Deregulation to Work, Surge Capacity Is Just the Beginning

By Richard Hillestad

Richard Hillestad is a senior mathematician at RAND. Others who collaborated with him to study an electric utility company were John Adams, Manuel Carrillo, Dan Relles, and the late Al Williams.

Deregulation of the electric power industry in the United States suffered a few shocks this past summer. In California, the first state where deregulation took effect, record wholesale prices for electricity in San Diego prompted the state legislature to impose a rate freeze, which is still in effect. The freeze forced the state's two biggest utilities,

Private utilities will be able to sacrifice neither efficiency nor reliability.

Pacific Gas & Electric and Southern California Edison, to absorb \$4 billion in costs that they could no longer pass along to customers. A coalition of 26 municipal utilities in the state has even pushed to "re-regulate" the market until problems in the wholesale market are corrected. Re-regulation would mean returning to the pre-1999 practice of tying electricity prices to each generator's cost of producing the electricity. Other states anticipating deregulation look warily toward California.

Some observers blame the California crisis on a lack of surge capacity—that is, the deregulated utilities simply did not amass an adequate supply of electricity to meet summertime peaks in demand. In this view, the recent problems should subside as companies adjust to the deregulated environment, adding new

generators to increase capacity and purchasing additional wholesale power. Indeed, the approach to managing risks in the past has been to amass large margins of standby power.

But the problem lies not just in adding enough capacity for a sunny day. The problem is complicated both by the inefficiencies of some utility operations and by the uncertainties inherent in electricity demand, uncertainties such as a sudden shift in the weather and various social factors. Public utilities can sacrifice efficiency for reliability by holding large reserves. Private utilities, on the other hand, will be able to sacrifice neither efficiency nor reliability.

To remain viable, competitive utilities will need to locate and eliminate inefficiencies. To remain reliable, the utilities will need tools to manage the underlying risks of uncertain demand. By reducing unnecessary costs, the utilities can avoid sending huge bills to customers. And by managing unavoidable risks, private utilities can serve the public interest by decreasing the chances of power outages.

We mapped out the operations of a large electric utility that expects to be deregulated soon and that feels the pressure to adjust to a cost-competitive environment. This utility serves about a third of the population of a major state, operates at a peak capacity similar to that of Southern California Edison, and relies on a typical mix of generators using gas-fired steam, gas turbines, coal, and nuclear power.

We worked with this utility to find ways for it to operate more efficiently and strategically. The methods we developed should be widely applicable to other electric power companies. Our recommendations

focused on three areas: (1) controlling costs by accounting for daily wear and tear, (2) predicting a sudden change in the weather 48 hours in advance, and (3) developing a decisionmaking tool to help operators manage the risks of residual uncertainty.

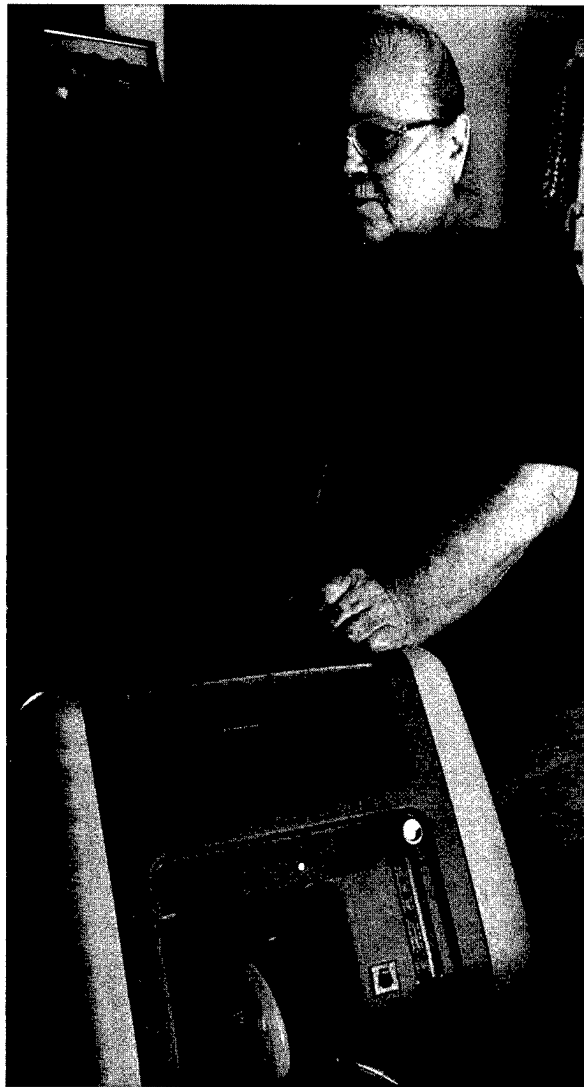
Uncertain Cost Figures

We discovered that daily judgments as to when to turn steam generators on and off were highly sensitive to wear-and-tear costs. These costs can be substantial, because the heat cycles involved in turning the generators on and off cause leaks, corrode the metal, and literally burn up the system. When the costs are underestimated, the planning software schedules more starts and stops than it should. Underestimating the costs also undervalues the importance of buying or selling power on the open market versus starting or stopping your own generators.

Despite the importance of wear-and-tear costs, there is considerable uncertainty about what these costs actually are for steam-plant generators, which are the generators used most. The estimated costs caused by firing up and cooling down these generators vary widely across the industry, ranging from \$1,000 to tens of thousands of dollars, depending on the generating units involved. Therefore, we set out to quantify the effects of alternative wear-and-tear costs.

As it turned out, the scheduling system was very sensitive even to quite minimal wear-and-tear costs. When the scheduling system included the costs, the scheduling software ordered many fewer starts and stops, and there was much less thrashing of the system. When steam-plant units simply remained on, both the number of starts and the total costs were slashed to less than a third of the usual weekly totals (see Figure 1).

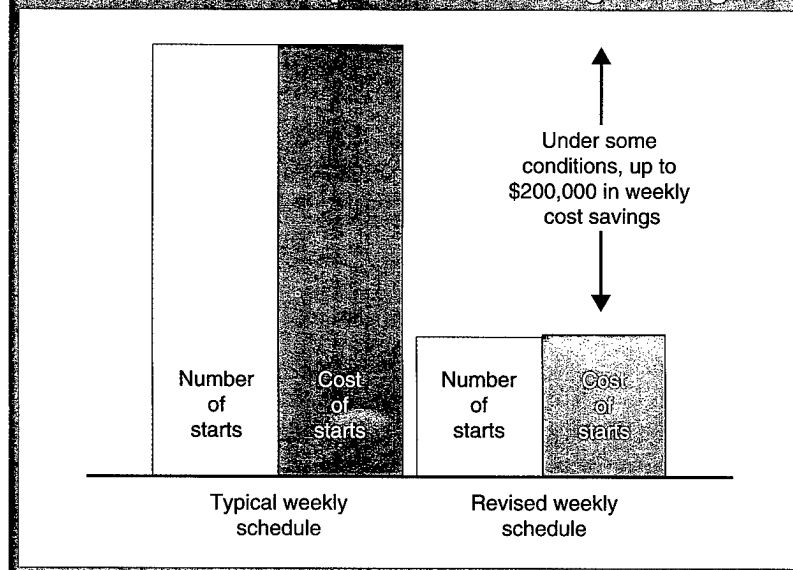
Scheduling with these costs in mind could save as much as \$200,000 a week for a utility of this size. The utility used this result as an incentive to sharpen its estimates of the wear-and-tear costs for each of its steam-plant generators. The utility now operates with these costs built into its planning and scheduling process.



Nora Whitcotton sits in her air-conditioned apartment in El Cajon, Calif., with her oxygen concentrator in July. She suffers from chronic pulmonary problems. Her electricity bill doubled under California's electricity deregulation, which was supposed to lower prices and set the standard for the nation. Bills doubled for many of San Diego Gas & Electric's 1.2 million customers until the state legislature imposed a rate freeze.

AP/WIDE WORLD PHOTOS/DENIS POROY

Figure 1
Accounting for Startup Wear-and-Tear Costs Can Lead to Smoother Operations and Large Savings



Uncertain Weather

The utility already used sophisticated tools to predict changes in temperature and subsequent demand.

These tools included computerized programs that use

We estimated the likelihood of unusual climatic events 48 hours ahead of time.

a continuous training process to recognize patterns in temperature and demand as well as social determinants of demand (such as work days, school days, weekends, and holidays). On average, these tools work well. They estimate demand correctly within about 1 percent, *as long as the temperature*

is predicted accurately. However, these tools virtually always miss unusual changes in the weather.

On rare days of some years, the utility experienced an unpredicted temperature drop from well above freezing to well below freezing within eight hours or less. On these days, the utility had to drop customers, because it could not start additional generating units fast enough. The weather had just changed too fast. The utility actually needed 24 to 48 hours to plan for these large changes. Sudden cold fronts are especially problematic because of the difficulty of firing up cold units.

To estimate the likelihood of unusual climatic events 48 hours ahead of time, we worked with a meteorologist to understand the mechanism for the unexpected changes in the weather. For cold weather,

the mechanism is the movement of a cold front from distances of 1,000 miles or more away. We then obtained weather measurements for North America for the past 30 years. We determined, statistically, the most likely locations and weather measurements that correlated with sudden temperature drops near the utility 48 hours out. We found that certain locations were good predictors, and the important weather measurements were primarily pressure and temperature differences between those locations and the utility's region. The pressure differences drove the cold temperatures. Secondary measurements were cloud and snow cover, which indicated how much the cold temperature 1,000 miles away might rise on its way to the utility's region.

First used in the winter of 1998, this estimator—called the Adams Index, in honor of its creator, John Adams—predicted three “bad days” from January through March of that year. The utility reacted by turning on extra generating units in anticipation. On two of those days, the cold front did come through; on the third, the cold front stalled just short of the utility's region. Even in this last case, however, the utility was able to sell the extra megawatts generated to a neighboring utility.

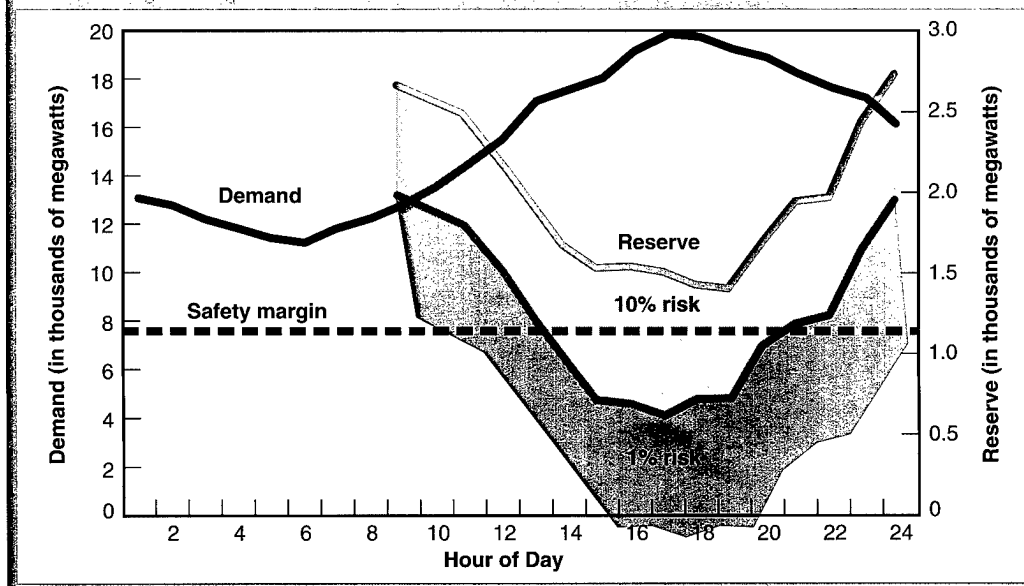
Uncertain Supply and Demand

The uncertainty of electricity supply stems from the potential for generators to break down. The uncertainty

of electricity demand stems from the inability to perfectly predict consumer needs for electricity.

A utility can cope with these uncertainties of supply and demand in a number of ways: (a) ignoring some uncertainties, (b) improving computerized predictions of demand, (c) compensating for errors in computerized predictions by switching on some expensive gas-turbine generators at the last minute, (d) buying or selling electricity hastily on the spot market rather than making longer-term purchases or sales, and (e) scheduling additional slack capacity (“spinning

Figure 2
Computing the Risk of a Schedule—and Comparing It to Alternatives—Can Help Keep Risks to a Minimum



reserve"). All of these coping mechanisms carry cost implications.

As an alternative to these mechanisms, we developed a mathematical model to compute the risk level of any planned schedule of generators. This model could then produce alternative schedules for different sets of assumptions and compare the risks and costs of the alternatives with the original schedule. This approach concedes that some amount of uncertainty is inevitable; however, by comparing the consequences of alternative schedules, this approach at least allows plant operators to compare risks and costs and keep them to a minimum.

To estimate the risk of a planned schedule, we started with historical information about the reliability of each generating unit. This information had been routinely collected by the utility. To update these historical estimates, the utility implemented a reporting system in which plant operators revised the data for any units experiencing problems. With the revised data, we could estimate the probability of failure of each generator at each hour of operation. Depending on which generators were scheduled to be operating at any hour, we could then derive hour-by-hour estimates of the megawatts at risk of being lost to generator failure. In addition to this risk on the supply side of the equation, we accounted for the risk of an unexpectedly high level of demand. We calculated this additional risk based on the utility's historical errors in predicting demand. Together, these two estimates constituted the total risk of a planned schedule.

The risk can be illustrated graphically, as shown in Figure 2, which shows the type of display developed for the utility. As the demand for electricity increases, the reserve capacity decreases. In this example, the reserve capacity is expected to decrease nearly to as low as the minimum reserve required by the utility as a safety margin. Plant operators worry when there is a significant risk of the reserve dropping below the established safety line.

Let's assume a worst-case scenario by subtracting the megawatts at risk during an hour of high demand—say, 5 p.m. At first, we subtract the amount of megawatts at risk at the 90 percent confidence level, which means there is only a 10 percent chance that these megawatts will be lost. With this loss, the available reserve dips below the safety margin. If we subtract the amount of megawatts at risk at the 99 percent confidence level, corresponding to a rare 1

percent chance of loss, the reserve would drop below zero. In the latter case, either customers must be dropped, or additional power must be purchased or generated.

The second part of this process allows dispatchers to compare the risks and costs of alternative schedules. The dispatchers can select a period of interest, schedule different generating units, and view the potential outcomes. In addition to the type of reliability risks shown in Figure 2, the dispatchers can also view the comparative effects on startup costs and marginal costs. The marginal costs are important for deciding whether to generate power or buy it on the open market instead.

Using this system, dispatchers can estimate the cost of keeping an unreliable generator on schedule as well as the cost of turning it off. They can decide more confidently if they should make their own power or buy it elsewhere. And they can reduce the worst possible consequences of generator failure or of erroneous predictions of demand.

We believe these approaches to managing costs and risks can be applied broadly across the electric power industry as it shifts to deregulation. Understanding and controlling costs will become much more important for competitive companies. Reliability certainly will remain a primary commodity demanded by all customers. Therefore, many utilities will need decision-support systems similar to those described here.

Even in a deregulated market of private utility companies, reliable electric power will still be an important benefit to the public. Therefore, for the sake of the public interest, let alone for the sake of efficiency, we believe that methods such as those we developed for this utility could be helpful to the electricity industry in general. ■

Some amount of uncertainty is inevitable; however, by comparing the consequences of alternative schedules, plant operators can at least compare risks and costs and keep them to a minimum.

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